

Talking About the Application Research of Antibiotics in Aquaculture Water Environment

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Abstract

Antibiotic resistance genes (ARGs), as a new type of environmental pollutant, are ubiquitous in various environmental media. However, the aquaculture environment is an important reservoir, and the research on ARGs is still fragmented. Find out the pollution status of ARGs in the aquaculture environment in my country Is the current priority. This article analyzes the sources and hazards of antibiotics in aquaculture water, and discusses the directions for further research in the future.

Keywords

Aquaculture water; Aquatic environment; Antibiotics; Harm.

1. Introduction

A Since humans invented penicillin in 1929, antibiotics have been widely used in medicine, animal husbandry and aquaculture. In 2013, about 162,000 tons of antibiotics were used in agriculture and medicine in China, of which 48% were used in humans and 52% were used in animals. Most antibiotics are excreted in the form of the mother's body or metabolism in urine and feces. In intensive farms, about 70-80% of the antibiotics used eventually enter the environment. Therefore, antibiotic pollution in the aquaculture industry has become the main source of water environmental pollution.

In recent years, the marine aquaculture industry in my country has developed rapidly. High-density aquaculture has led to the outbreak of bacterial diseases and reduced the output of aquatic products, affecting the development of the industry. In order to prevent and treat the occurrence of diseases, a variety of antibiotics are used as effective antibacterial drugs in large quantities in the breeding process. At the same time, it is added to feed as a growth promoter in the animal husbandry industry. The concentration range of residual antibiotics detected in the environment is ng/L-μg/L. These large amounts of unabsorbed antibiotics will eventually enter the water environment through a variety of ways, and the residues of antibiotics will also cause the aquatic animals themselves and the production of microbial resistance in the water environment, destroying the biodiversity and ecology of the aquaculture environment balance. In addition, the residual drugs in aquatic products will be passed along the food chain and accumulated, posing a potential threat to human health.

2. Sources of Antibiotics in Aquaculture Water Environment

After antibiotics are ingested into the body, they undergo oxidation and lysis reactions through metabolism and absorption. Antibiotics that have not been absorbed and degraded will eventually enter the environment (groundwater and surface water) through their own excreted feces and urine. The main sources of antibiotics in the water environment are divided into the following categories: (1) sewage treatment plants; (2) medical wastewater; (3) livestock and aquaculture; (4) agricultural wastewater, etc. Studies have shown that 30-75% of antibiotics used in animal husbandry and aquaculture are directly excreted through feces without being

absorbed, and 80% of the feces are untreated, directly used in farmland and fishery to fertilize, and eventually sink into surface runoff. In addition, in order to prevent and treat fish diseases, aquaculture farmers directly put a large amount of antibiotics into the water body, making a large amount of antibiotics remain in the aquaculture water environment. According to the survey, the average concentrations of oxytetracycline, tetracycline, sulfamethazine, and sulfonamide detected in the wastewater of a livestock farm in Jiangsu Province were 72.9, 10.3, 211, and 63.6 $\mu\text{g/L}$, respectively. Denmark uses more than 110 tons of antibiotics each year, of which more than 50% are used as growth agents in animal husbandry and prevention of aquatic diseases. In 2004, the amount of antibiotics used in animal husbandry and aquaculture in South Korea was as high as about 1,400 tons. In China, since the early 1990s, with the development of animal husbandry and aquaculture, the average annual consumption has exceeded 6000 tons.

3. The Harm of Antibiotics in Aquaculture Water Environment

A large number of antibiotics residues in a variety of environmental media pose potential risks to human health and safety, and arouse more and more public attention. The abuse of antibiotics will lead to the birth of "super bacteria", which will further increase the dosage of antibiotics, and more and more antibiotics will become ineffective, increasing the demand for research and development of new drugs. The main sources of abuse of antibiotics are as follows: human diseases are overly dependent on antibiotics; antibiotics are added to feed for animal growth and disease prevention. The long-term excessive use and discharge of antibiotics and their non-degradability have caused them to be "pseudo-persistent" in water bodies, causing health risks.

3.1. Drug Resistance

Antibiotics remain in the water environment for a long time, causing bacteria to develop drug resistance. Posing a threat to human health, the currently known antibiotics have been ineffective against a large number of diseases. Feng Shiwen found that the drug resistance rates of penicillin G, ampicillin, amoxicillin, rifampicin, lincomycin and compound trimethoprim in 180 strains of pig-derived *Escherichia coli* isolated in Guangxi were all higher than 90%. A survey of aquaculture in coastal areas of Jiangsu Province revealed that the main pathogenic bacteria showed strong resistance to sulfisoxazole, doxycycline, tetracycline and penicillin, and the resistance rates were 66.16%, 31.12%, and 30.66, respectively. % And 64.23%; resistance rates to ciprofloxacin, enrofloxacin, neomycin, ofloxacin, ceftriaxone, erythromycin, norfloxacin and florfenicol were lower, followed by 5.84%, 6.59%, 5.11%, 6.55%, 3.65%, 8.03%, 9.49%.

3.2. Toxic Effects

Residual or untreated antibiotics continuously migrate and transform in the water environment, which may unselectively kill the organisms and microorganisms in the environment, and also induce the production of drug-resistant flora, thereby Harmful to the environment. There are many studies on the toxicity of antibiotics at home and abroad. Studies have shown that low-dose antibiotics can promote the growth and development of fish, while long-term low-dose exposure to antibiotics has safety risks, especially for animals in embryonic development. Exposing zebrafish embryos with 0.2, 20, or 2000 $\mu\text{g/L}$ sulfamethazine will cause the embryonic hatching rate to decrease, the malformation rate to increase, the heart rate to increase, and the body length to decrease. Soaked with florfenicol for the larvae, larvae and postlarvae of *Penaeus Vannamei* and the juveniles of *Haliotis discus* (*Haliotis discus*), the LC_{50} was 64 mg/L (24 h) and 64-100, respectively. mg/L (48 h) and 163 mg/L (96 h). In addition, florfenicol exposure can also cause fish to produce immunosuppression and oxidative stress. After florfenicol (10 mg/kg BW/d) is used to treat rainbow trout for 10 days, T cells and B cells in the head and kidneys The proliferation ability and the activity of phagocytes are significantly

inhibited. According to the classification standard of acute activity inhibition toxicity of fleas, enrofloxacin is a toxic compound to *Daphnia carinata*. The LC50 at 48 h is 25.68 µg/mL. Enrofloxacin at high concentrations shows higher reproduction. Toxicity. In addition, the four antibacterial drugs commonly used in aquaculture (doramicin, metronidazole, florfenicol, and oxytetracycline) can affect non-target organisms in aquatic ecosystems, such as marine *Vibrio fischer*, *Scenedesmus obliquus* (*Scenedesmus obliquus*), duckweed (*Lemna minor*) and *Daphnia* (*Daphnia*) all have significant toxic effects. Another study clarified that florfenicol and thiamphenicol inhibit the growth of *Chlorella* in a time-dose-dependent manner, with EC50 (48 h) of 10 and 84 mg/L, respectively. It also shows that florfenicol stimulates the growth of *Chlorella* at concentrations of 0.5, 1.0 and 2.0 mg/L. When it is >2.0 mg/L, it significantly inhibits the growth, and the inhibition rate is the highest at 16.0 mg/L, up to 86%. According to the toxicity classification standard, florfenicol belongs to the low toxicity level. As an alternative to chloramphenicol, florfenicol removes the para-nitro group in the molecular structure, which greatly reduces its toxicity to animals and humans. Enrofloxacin is of low grade, but after its metabolite ciprofloxacin enters the water body, there is a certain ecological risk.

3.3. Destroy the Balance of the Aquatic Ecosystem

In the aquatic environment system, aquatic microorganisms are an indispensable part and play a vital role in the circulation of materials and energy flow. Marine microalgae are primary producers in marine aquatic ecosystems. They can provide oxygen and food for aquatic organisms such as molluscs, crustaceans and fishes in water bodies through photosynthesis. The diversity of their species and primary production directly affect the entire aquatic life. The structure and function of the system. After the antibiotics in the water body are enriched, they will also affect the activity of microorganisms and microalgae and break the balance of the ecosystem when inhibiting or eliminating their pathogenic microorganisms.

4. Conclusion

At present, ARGs in the aquaculture environment have been commonly detected and urgently need to be paid attention to. However, the pollution status of ARGs in the aquaculture environment in my country is still unclear, and the research on ARGs is still in the discovery stage. The research and development of antibacterial drugs is becoming more and more difficult. To fundamentally prevent the occurrence and spread of antibiotic resistance, future research on ARGs in aquaculture environments can capture the following points:

In-depth analysis of the relationship between ARGs in the aquaculture environment, aquatic products, and human pathogenic bacteria. Although it has been found that ARGs in aquaculture can threaten humans through the food chain, and human intestinal flora and pathogenic bacteria carry ARGs. Have similarities, but lack more evidence and research on related mechanisms.

Explore the influence of mainstream culture mode, temperature, heavy metal salt disinfectant and other adjustable factors in the aquaculture process on the occurrence and spread of ARGs, understand its influence mechanism, and effectively control the occurrence, spread and even removal of ARGs during the aquaculture process

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